AN

INTRODUCTORY LECTURE

ON THE

ADVANTAGES AND PLEASURES

OF THE STUDY OF

CHEMISTRY,

DELIVERED IN THE

CHEMICAL LABORATORY

OF

TRANSYLVANIA UNIVERSITY

On the 11*th Nov.* 1831,

AND PUBLISHED AT THE REQUEST OF THE CLASS.

BY LUNSFORD P. YANDELL, M. D.

LEXINGTON:
PRINTED BY N. L. FINNELL & J. F. HERNDON.
1831.

CORRESPONDENCE.

Medical Hall, Lexington, Ky. Nov. 14th, 1831.

Dear Sir—In behalf of the Medical Class here assembled, we respectfully request for publication, a copy of your very appropriate and highly interesting Introductory Lecture, delivered on the 11th instant, before the Medical Faculty and Students of Transylvania.

We indulge the hope, Sir, that in entering upon the important duties of the Chair lately assigned you, in one of the most renowned and favored institutions of the country, you will not withhold from the public eye, a production so creditable to yourself, and so worthy of the station you now occupy, as that, to which it is the wish of the Class to give publicity.

With great respect, yours, &c.

JAMES N. HUGHES,
TH. J. MARTIN,
EDWARD B. CHURCH,
A. P. WHEELER,
ALGERNON S. VAUGHAN,
ROBERT D. WEBB.

L. P. Yandell, M. D. *Prof. Chemistry in T. U.*

Lexington, November 15th, 1831.

Gentlemen—In reply to your very polite note of yesterday, requesting, in behalf of the Medical Class, a copy of my Introductory Lecture for publication, permit me to say, that whatever may be my own misgivings on the subject, I do not feel at liberty to refuse a request made under such circumstances, and in language so complimentary.

Your desire to give extension to the views contained in the Lecture, satisfies me of at least one fact—that the Class which I had the honor to address on the occasion referred to, hold in just estimation the interesting science which it was the aim of that Lecture to recommend.

With sentiments of high regard,
I have the honor to be, Gentlemen,
Very truly, your obedient servant,

L. P. YANDELL.

Messrs. Jas. N. Hughes, Th. J. Martin,
Edw'd B. Church, A. P. Wheeler,
A. S. Vaughan, Robt. D. Webb.

LECTURE.

GENTLEMEN:

THE occasion on which I now appear before you, is to me one of strong emotion. But a few years having elapsed since I was myself a pupil in this University, it is with no affected diffidence that I now rise to claim your attention in the capacity of a teacher. If I may not dissemble the gratification which I feel at being thus honored, the solemn responsibility attached to the calling, be assured, is neither unknown to me, nor lightly regarded. I trust my deportment will not fail to testify that my sense of it is as deep as it is conscientious. I am fully aware, that while I hazard in it my own reputation, which is of more importance to me than life, my performance of the duties, to which I have been invited, must have some effect, for good or for evil, not only on this institution, but in preparing you for the profession which you have chosen,—a profession, not surpassed by any other, in its elevation and bearing on the welfare of society.

Since my appointment to the place where I now stand was first announced to me, these considerations have never been forgotten. But while they fill me with solicitude, they do not entirely bury me in despondence. They will only serve, on the contrary, to confirm my patience in research and preparation, and invigorate my efforts under a determination to do well. And limited as my experience and observation are, they have nevertheless taught me, that in most of the arduous enterprises of life, industry and perseverance accomplish more than genius and talent. And these, fortunately, are at the command of every one. As far, therefore, as they will go towards accomplishing a task which I regard as in the highest degree both difficult and responsible, I flatter myself I may be permitted to promise, without incurring the charge of presumption, that I shall not be found wanting.

Nor am I compelled to rest my hopes, in the performance of my duties, entirely on my own unaided efforts. On the labors of my colleague, of whose qualifications and accomplishments his presence here renders it improper that I should speak, I have much well-grounded reliance. You have a sufficient

guaranty in his success as a teacher elsewhere, that he will not fail within these walls.

To these remarks I shall only add, that I do not feel at liberty to doubt the disposition on your part, to extend to me, in all cases, that degree of liberal indulgence which the enlightened and ingenuous never withhold.

And now permit me to proceed to the subject of my address. My duty, as you are aware, in the chair which I have the honor to occupy, is to give instruction in Chemistry; and I have concluded that I could not do better on the present occasion, than to present you with a brief view of the importance of that science, accompanied by a few of those beautiful, curious, and interesting facts which have riveted the attention, and even excited the wonder of the civilized world.

That Chemistry, as a branch of scientific and collegiate education, has been greatly undervalued, not to say, seriously neglected, in the Western country, is a fact which, it is believed, will not be called in question. It would constitute a subject of curious inquiry how many thorough chemists we should be able to find in all our colleges and universities—averaging some three or four for each state, in all the older states of the west. How many who could analyze with accuracy, a medicinal spring, or detect the composition of a new mineral? Who, after examintion, could pronounce positively, in a court of justice, upon the existence of a suspected poison? who, if required, could prepare for a physician prussic acid, or caustic potash, or sulphate of quinine? or who could determine the proportion of alloy in a counterfeit coin as was done by Archimedes for Hiero, more than two thousand years ago?

But, that Chemistry is a science, most important in its bearing, and of wide and varied relations, not only presenting to the mind of the student the most striking facts, and unfolding some of the most interesting laws of nature, but constituting for the professional man a field of knowledge as indispensable, as for the general scholar it is replete with attractions, is a truth, universally received in other countries, and which will not long be questioned in ours. To be satisfied that medicine rests upon it, *as a chief corner stone*, let me entreat you to cast your eyes over the Materia Medica, and count the remedies which the physician has not received at the hands of the Chemist. Beginning with *Raymond Lully*, who discovered nitric acid in the 13th century, or with *Basil Valentine*, who, about the close of the 15th, introduced into practice, mercury, antimony and sulphuric acid, and coming down to our own times, you will find

very few of high value, which may not be pointed to as trophies of the science which it is our object, in this address, to recommend. Those which it did not furnish, it has improved. It has given us accuracy—and in a most momentous concern—where every thing was once vague and uncertain;—and comparative elegance and comfort, where all before was loathsome and revolting.

For opium, which, after producing sleep, disturbs the system with subsequent fever and restlessness, it has given us morphine, which, as its name imports, induces a sleep at once tranquil and refreshing. In place of the ponderous, and offensive barks, it has substituted quinine, which the patient is able to swallow, almost without tasting it. By means of the oil of cantharidin, infused into a piece of paper, it is in our power to produce vesication, promptly and effectually, with the saving to the patient at the same time, of much of the pain of blistering. Iodine, an active remedy which has been applied successfully to the cure of a number of diseases, and whose remedial application, there is reason to believe, will yet be greatly extended, is a discovery of this science, which, 20 years ago, was unknown to the profession. The medical properties of sarsaparilla have lately been obtained in a form convenient to the physician, and less disagreeable to the patient. Piperine and strychnine are of comparatively recent discovery, and we are warranted in anticipating the most beneficial results from their extensive application to the treatment of diseases. And, from some late researches on the subject, there seems ground for the belief, that the principle which the Chemist extracts from *coffee*—the delightful morning and evening beverage of so many thousand persons—may be added, with advantage, to the already extended list of remedies for that most obstinate malady—*intermitent* fever. Chlorine is growing into extensive use as a *disinfecting agent*. The fate of too many new medicines ushered into the world with the most unmeasured eulogy, admonishes us to speak modestly of untried remedies. But if any reliance may be placed on public statements, it is not too much to hope, that chlorine may yet be made as effectual in destroying the contagion of small pox, and similar diseases, as it has proved, in the arts, in the removal of colors. *M. Labarraque* believes he has shewn "the possibility by means of it, of rendering the propagation of contagious or infectious diseases *impossible*."* Time will not allow us to speak of salicine, prussic

*Dr. Robert (Guide Sanitaire, p. 793) remarks: "The success which has been obtained in the course of last summer to combat, to arrest, or to prevent

acid, phosphorus acid, and a number of other articles brought to light by the labors of modern Chemists, and which, it is hoped, may become invaluable resources to the physician, in the further improvement of the healing art.

If, therefore, in the early ages of medicine, Chemists were the discoverers of the most useful remedies, it is no less true, that the labors of these men are extending the materia medica in our own day, and that Majendie, Dumas, Pelletier, Gay-Lussac, and others, are contributing a full share to the improvement of our profession.

Let me ask seriously, whether any physician, educated at

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the disease which attacked horses, a discase which may be considered as a pestilential epizootic or gangrenous typhus, imminently contagious, leads us to presume that they (the chlorurets) may be equally efficacious in the pestilential diseases of man, and with so much greater reason, since the experiments recently made by M. Lisfranc, surgeon in chief of the hospital La Pitie, in Paris, prove that the air of wards where small-pox patients are confined, no longer communicates the disease, whilst daily sprinklings with solutions of the chlorurets are employed."

"M. Labarraque communicated personally to the author (Alcock, on the use of chlorurets of oxide of sodium and of lime, p. 58,) that the infection arising from measles, which had occurred in a boarding school, had been perfectly arrested, without the removal of any of the pupils, this security from infection having been effected by the free use of the chlorurets."

The same author continues: "The beneficial results already obtained in arresting the ravages of infectious diseases, afford a well grounded presumption that the chlorurets may also be effectual in preventing the ravages of the plague, the yellow fever and other pestilential disorders."

The following interesting case of Asphyxia, successfully treated by M. Labarraque, and related in the 8th volume of the Archives, is quoted by the same author:

"A workman of a vermicelli maker was exposed to a deleterious gas which proceeded from an accumulation of filth and rubbish, heaped together from a pit of night-soil which was undergoing repair. He fell without consciousness. M. Labarraque was called to the patient soon after the accident; the symptoms were, pulse strong but fugitive on pressure, excessive rigidity of the limbs; arms stretched, stiff, and almost cold; head thrown backwards; veins of the neck turgid; face violet colored—also the lips, which were much swollen; eyes closed, dull and insensible; respiration appeared extinct; the danger seemed imminent. M. Labarraque details the train of reasoning which led him to adopt immediately the concentrated solution of the chloruret of oxide of sodium. A napkin moistened in the solution, was placed under the patient's nostrils, and in less than one minute he uttered an acute and plaintive cry or groan: the rigidity ceased; his eyes opened to shut again in a few seconds: the tetanic rigidity had re-appeared with its frightful train. I (M. L.) had withdrawn the chloruret too soon. The usual stimulents again tried, produced no effect. The chloruret was re-applied: in less than a minute the rigidity of the limbs ceased and the patient sent forth a piercing cry, which was stopped by the linen impregnated by the chloruret. A full inspiration took place, the air necessarily passing through the moistened linen, was therefore charged with chloruret saturated with water. The disinfection of the gas contained in the chest was no doubt complete, since the symptoms ceased: He was made to walk into the street, keeping the chloruret under his nostrils—his countenance regained its natural appearance, and he was soon in a condition to resume his work."

this period, and in a University where all the branches of medicine are professed to be taught, can reconcile it to his feelings, to remain ignorant of the ingredients which enter into the composition of his remedies? It is not required that he should possess the skill to manufacture them. But can he be satisfied while he is unacqnainted with the chemical difference between cream of tartar and tartar emetic, between calomel and corrosive sublimate, between oxalic and tartaric acid? Will any gentleman agree to take leave of his *alma mater*, invested with the honors of the doctorate, without an acquaintance with the antidotes to the many poisons, which, by accident at first, and through ignorance afterwards, are so often proving fatal to human life? Instances not unfrequently occur, where corrosive sublimate has been taken for calomel, or oxalic acid for epsom salts, or tartar emetic for cream of tartar; or, where these, and other poisons, have been administered with felonious intentions. What must be the mortification and the agony of the physician, who, summoned to render aid under circumstances so afflicting, and conscious that effectual remedies exist, is yet precluded by his ignorance from a resort to them? Whatever may have been heretofore the charity of the public, in the indulgent exercise of which, deficiences so palpable and gross have been excused, we may rest assured that the period has arrived when such ignorance will meet with neither the connivance, nor the toleration of society. The march of improvement in the West is onward. The attainments of physicians must be extended also. The armor of the Faculty must be polished anew. It is the prerogative of the medical profession to stand on elevated ground. Its votaries are permitted, and it is their imperative duty, to follow nature into her inmost recesses, and witness the mystery and magnificence of her hidden operations. It holds connexion and claims support, from every other science; from mineralogy with its gems, and botany with its flowers. And a calling of such concern is privileged thus to exact the aid of every department of knowledge. What does it not embrace, that is valuable in life? Not health alone, for if the mind stood firm, there might be something of life enjoyed without this. Not *bodily* strength alone, for this might be surrendered could we retain the vigor of our divine part. Nor the happiness of individuals alone; but the health, the happiness, the well-being of communities, of nations—the body, the mind, all are involved in the profession of medicine! To this profession, the palm of learning has been assigned by Dr. Parr, who was himself, incomparably the most learned man of

his day; and by Jefferson, Dr. Johnson, Sully and others not less distinguished. Be it ours to maintain an ascendency so honorable.

A task somewhat peculiar belongs to the medical profession of the West, in the execution of which, a knowledge of chemistry becomes indispensable. The physical character of our extended valley has yet to be illustrated. Its geological formations have not been explored; the character, locality and richness of its minerals have not been ascertained, and especially, its mineral waters remain to be analyzed. Here is a harvest just ripening for the sickle, with scarcely a laborer to divide with you its honors or its rewards. Much, we have reason to be assured, exists in the structure of our rocks, to instruct and delight the Naturalist; mineral treasures doubtless abound, which when developed, will enrich communities as well as individuals; and medicinal springs are scattered all over the country, whose waters have proved effectual where medicine had failed. They all pass under the general vague names of *sulphur* and *chalybeate*, and nothing is known of them further, save that dyspeptics, and hypochondriacs, and other valetudinarians have resorted to them and been healed.

These springs constitute a portion of the wealth of every country. Besides the recreation and luxury of visiting them during the heats of summer, many of them possess decided efficacy in numerous chronic complaints. Those containing iron are known to be adapted to cases of debility; but they produce mischief where inflammation exists. To one class of patients, those containing magnesia, and other aperient articles might be well adapted; and yet they would scarcely fail to aggravate the complaints of another class who suffered from extreme debility. But how are the sick to make these discriminations, when their medical advisers are as blind as themselves? And *experience*, in such cases, might prove too dear a teacher.

It will come to be regarded as a stigma upon the West, if the investigation of these sources of health and comfort is much longer neglected. The only ground upon which past dereliction has been excused, is our infancy. While every other quarter of the globe is pouring its treasures into the storehouse of science, will it not cause the cheek of patriotic pride to mantle with shame, that our great valley, rich as it is in minerals, rich in animal and vegetable productions, and not less rich, let me add, in native intellect, should alone withhold its contributions? The long cheerless night which brooded over it du-

ring the generations of the race which has just disappeared, only *begun to give way*, with the coming of their successors. The grey of the morning, as regards its science, still hangs around it, and we are just beginning to anticipate a brighter day. Let me indulge a hope, that I behold before me, at this time, the ardent, intrepid corps, before whose labors, the last lingerings of this intellectual night will finally disappear. We cannot be mere physicians. We must be members, (we ought to be cultivated, variously taught, armed with knowledge at all points) of a great, busy community, of multiform interests and vocations. With all these chemistry is connected; to all it lends its light to instruct, to gratify and improve.

In many processes of domestic economy, a knowledge of the principles of the science is of signal advantage. From the baking of bread to the construction of our fire-places, from the regulation of our apparel to the erection of metallic rods for the defence of our dwellings, these principles are put in requisition.

The lime-maker who exposes his rocks to an intense fire, for the purpose of driving off the carbonic acid, of which limestone is, in part composed, is as much the Chemist, perhaps without suspecting it, as he who obtains oxygen by a similar process, from manganese, or nitre, in his laboratory. So the house-keeper who adds quick-lime to lye for the purpose of giving it strength, and oil afterwards, to convert it into soap, avails herself of chemical affinities, how little soever she may understand of their nature. And the farmer, who spreads lime, or plaster of Paris over his fields, and the black-smith with his bellows, the forger of iron, the assayer of silver, the tanner, and the manufacturer of steel, gun-powder, glass and porcelain, are all chemists, it may be, without an acquaintance with the principles of the science.

Chemistry is at the foundation not only of these, but almost every other art. It assists the brewer, and the maker of wine. The dyer of stuffs is aided by it, and the bleacher of cloths, taking advantage of the instruction which it affords, accomplishes now in weeks, what was once the work of months. The refining of sugar is a process conducted upon principles strictly chemical, and an improvement made in it, by an accomplished Chemist, a few years since, was the means of enriching, with slight expense, and almost without trouble, most of the persons engaged in the business. The safety lamp of Sir Humphrey Davy, which has been truly called "the most beautiful and useful invention of modern times," and which is a glorious

triumph of the science over destruction, was made by one whose life was devoted to its cultivation. Until the time of this invention hundreds of miners were sacrificed, in their useful calling, by the explosion of carburetted hydrogen gas. Dr. Wollaston had observed, that this gas could not be kindled in a glass tube so narrow as one seventh of an inch in diameter; and profiting by the discovery, Sir Humphrey constructed this invaluable instrument, which, while it guides the miner in his labors, shields him effectually from all danger. Finally, the steam engine, which performs now half the work of society, the conquests of which have already surpassed what fancy had conceived, and whose future conquests promise to extend further than imagination can reach, is a chemical instrument, and owes its discovery to a philosopher who thoroughly understood the principles of the science.

Nor, we are permitted to believe, has Chemistry yet conferred upon the arts all the benefits of which it is capable. Even while we are here discussing the subject, the public journals are bringing us accounts of the manufacture of an illuminating gas *from water*. The hydrogen which the water on decomposition affords, is passed, according to the account, through a liquid obtained during the distillation of pit-coal, which causes it afterwards to give out a bright light in combustion. Thus, it is playfully remarked, "the exploit of 'setting the great river on fire,' which our ancestors, in the simplicity of their hearts, reckoned among the number of impossibilities, is now in a fair way of being performed. The cold waters drawn from the bosom of the earth, are to be distributed in currents of flame, from habitation to habitation, and the element which we use to quench fires, is to light up our cities, with a brilliancy scarcely to be surpassed by that of a conflagration. When the anthracite mines of the country shall be exhausted, and our forests all hewn away, our posterity will be able to keep themselves warm by burning the lakes and rivers."

Why is it that the tradesmen of Great Britain, as has been truly remarked, "can furnish at this day, more profound thinkers on philosophical subjects, more acute and accurate experimenters, more real philosophers, thrice told, than all Europe could furnish a century ago?" It is because Chemistry and the physical sciences have attracted there the attention due them.

If the same encomium pronounced upon the tradesmen of America, would sound, at this time, like "satire in disguise," I am not sure, since the opportunities afforded them, by Lyceums and other popular, literary institutions, for acquiring a

knowledge of these sciences, are so much increased, that it will long be so. And hence the members of our learned and liberal profession will be forced to extend their knowledge in this direction, or see themselves excelled by men of much humbler pretensions.

Another inducement to the prosecution of this study: The great mass of the people of our country live not only by the sweat of the brow, but by the tillage of the soil. Among this people, you are going when you have completed your labours here, to fix your homes. What are their interests must become yours, as they are those of all classes of the community. When they prosper, every other trade, and profession must prosper. What more agreeable task, then, could you desire, than to instruct this most useful class, in the application of *Chemistry* to *agriculture;* which, while it enriches *them*, will benefit yourselves? Glauber labored to make this application, while Van Helmont was shewing the connexion between medicine and chemistry, nearly two centuries ago, and it is singular that whilst all his other discoveries have been turned to good account, this the most important of them, should have been so lightly regarded. Sir Humphrey Davy, of whom it is as true, as of the individual to whom the remark was at first applied, that "he touched nothing which he did not adorn," rendered the study of Chemistry in connexion with agriculture fashionable in England by his Lectures on that subject. But the influence cannot be said to have reached this country. Be the intelligence of our agriculturists on other subjects what it may, (and no one has a higher respect for it than the author of this address,) it is useless to deny, that upon this, there prevails among them a lamentable degree of ignorance. Of the *science* of agriculture, it may indeed be said, that they know almost nothing. Lime, plaster of Paris, and occasionally burnt clay, are spread upon our fields, but their *modus operandi* is as thoroughly a secret, as if the whole process were an act of incantation. Whether the soil is argillaceous or calcareous magnesian or silicious, whether vegetable matter is deficient or in excess, are questions, which, however necessary to be determined, when an attempt is about making to increase its fertility, are such as the science of a whole nighbourhood would not be sufficint to answer.

It is, hence, in your power to become (and I trust the classes of this University *will* become, by promoting the study of chemistry, by getting up Lyceums, and in Lectures, pointing out the improvements which chemistry is capable of making in it)

the efficient patrons of agriculture, than which, Cicero has said, "no calling is more dignified or delightful, or more becoming a free man." And, as the bread cast upon the waters was gathered up after many days, you will have the gratification of seeing a community increasing in knowledge, and growing in prosperity by means of the light disseminated by your labors.

If then, you would form an adequate conception of the range and importance of chemistry, you must look back over the arts which it has invented and improved, and of which but a part have been enumerated. And it will not fail to be perceived, that of the principles of all these, he must remain ignorant, who is unacquainted with chemical science. So much of the volume of nature, he will find himself unable to interpret. The fire that blazes cheerfully on his hearth, will not be more intelligible to him, than the fire that bursts from the bowels of the volcano. The rain that falls, the wind that blows, the freezing of water, and a thousand such familiar occurrences, must present to his mind a perpetual mystery.

Such is the value of this science. But, apart from its utility chemistry opens a field of investigation, in which the mind is delighted with the discovery of new and striking truths. And this is a pure, elevated, and enduring pleasure, a pleasure known to every student of nature, and which has this advantage over most others; that it is exhaustless, terminating only with the discovery of all truth; that it is purely intellectual, and consequently can never pall; that it is wholly without alloy, since it carries with it the approbation of the conscience. Such was the emotion of Sir Isaac Newton, on approaching one of the most important of his discoveries, that it is said, he was compelled to give up the calculation in which he was engaged to be completed by a friend. And Archimedes is said to have been so transported by the discovery of the means of determining specific gravity, that he ran from the bath, in which he happened to be at the time, proclaiming it through the streets of Syracuse.

If a traveller should propose to lead you to a new country, whose scenery had no likeness in any thing with which you were acquainted, whose animals were of new species, and of great value, which abounded in beautiful and precious gems, and whose surface smiled with rare, and useful plants and flowers, need I say that you would be impatient to visit it? And, if it were added, that its position was remote, and that the road to it was steep, and difficult of ascent, would this daunt your man-

ly spirits which say, that "the joys of conquest are the joys of a man?"

But the Chemist proposes to open to your view a world, upon the like of which the eyes of the uninitiated never rested, which, lying below the surface of things, yet presents laws and transformations having nothing more remarkable in the descriptions of fairy-land.

What, for example, is better calculated to strike us with surprise, than that the sun-beam, which, to all appearance, is one of the most simple of substances, and which is so light that it does not affect the most delicate balance, should yet be divisible into seven prismatic colors, and that besides these, which occasion light, it contains other colorless rays which produce heat, others again which separate oxygen from its compounds, and yet others, which render iron magnetic; or that, from the combination of these seven colors, red, orange, yellow, green, blue, indigo and violet, *white* should result, which is generally esteemed *no color?* Or that this simple sun-beam, variously reflected, should give rise to all the hues which we meet with in creation; as well that of the verdant mead, as that which adorns the pigeon's neck, and that which delights us in the azure vault, or the rain-bow, and even that which we admire in the blooming cheek of beauty?

But this is not more remarkable than the fact, that a number of zinc and copper plates, alternately arranged, in the form of a Galvanic Battery, should be capable of exciting a degree of heat sufficient to burn gold, and to melt platinum, which resists the heat of the strongest furnace, as wax melts before the fire.

The student of this science meets, perhaps, with nothing more admirable, than that phenomena so varied and so numerous, should result from the operation of a few simple laws; and that from elements so limited in number, there should arise such endless variety in the modifications of matter. The combination of oxygen with a combustible, is the source of more than half the changes going on in the world around us. It is this operation which we witness in the combustion of our wood and candles. It is this which we observe in the rusting of metals, in the formation of nearly all the acids, in the conversion of many solids into gases, and in the respiration of animals. It is the same which we see in the wonderful phenomena of the *compound blow-pipe*, where the union of hydrogen and oxygen is attended with the most intense heat, and where the result of the combustion is water. It is also the same principle in operation in the brilliant experiments with the *Deflagrator*, in

which metals and charcoal are consumed with an intensity of light, scarcely surpassed by that of the mid-day sun. And yet what processes are more unlike each other than the rusting of metals, the burning of wood or candles, the production of acids, and our own respiration?

The fruitfulness of nature in producing variety out of a few elements is exemplified by *carbon*, in its various forms and combinations. This substance composes, in a good degree, the fuel which we consume, whether in the form of wood or coal, the food upon which we subsist, the clothing which we wear, and the materials for artificial light. It constitutes, chiefly, the feathers of birds, the hair of quadrupeds, the scales of fish and reptiles, and the fat of all animals. In combination with oxygen, it enters largely into the composition of our limestone rocks, is the sparkling ingredient of soda-water, beer, cider, and champaign wine, abounds in many mineral springs, and is found in nearly all our spring and well water, for without it, even this "pure antediluvian beverage," would be comparatively vapid. With oxygen, it forms an aerial acid. With hydrogen, an inflammable gas. In one form it appears as charcoal, in another as the brilliant diamond, and in a third, as plumbago or black lead. Vegetables mainly subsist upon it; and, in combination with oxygen, hydrogen and azote, it is the largest ingredient in the composition of our own bodies. In the shape of a gas, it is escaping continually from the lungs of animals, and from decomposing vegetable and animal matter. It is computed that 11 ounces troy, are disengaged from the blood every 24 hours; which amounts to more than twice the weight of a living man in the course of a year. In *one* shape it is one of the most friendly agents which man has under his control, contributing liberally to his enjoyment, and even sustaining his life. In another, it is the reverse. Its action upon the lungs in the form of an oxide or acid, is eminently poisonous, producing death in a few moments, as happens to animals exposed to the *Grotto Del Cani*, near Naples, and as has befallen many an unwary laborer, from descending into old wells. A substance thus deleterious and so extensively generated, would become, in a short time, a source of much inconvenience, and even lead to the extinction of animal beings, were not ample provision made in nature for its removal. But here, as in all other cases, we witness that perfect system of checks and balances, by which all things are kept within their proper sphere, and harmony and order are made to result. Water has a strong affinity for it, and its base is the food of

plants, and hence it is no sooner disengaged, than our seas, lakes and running streams are greedy to devour it, and myriads of vegetable mouths receive it as their fit aliment.

In this manner, the vegetable kingdom, aided by collections of water, performs the office of a great depurator of the atmosphere, which is becoming constantly defiled by the contact of animals. Thus, by a wonderful agency, we see poisons converted into healthy food; and that out of a single element, variously modified and combined, are formed the clothes which adorn our persons, the fires which warm us in winter, the light which cheers the gloom of our long nights, and much of the aliment by which we are sustained.

We see, moreover, in these changes, an admirable provision made for the growth, decay, and re-production of animals and vegetables. The carbon which had become offensive to animals is expelled in respiration, enters into the composition of plants and contributes to their growth, and comes in circling years again to be the food of animals. So too, when animals die, and are resolved into their primary elements—when, in other language, *dust returns to dust*, these elements, mingling with the soil, or floating in the atmosphere, are again imbibed by plants and made subservient to their wants: The two kingdoms seeming thus engaged in the practice of mutual reprisals; or, in another view of the subject, to constitute a circle of harmonious changes. In view of this simple and beautiful round of action, well may the student of nature exclaim with the poet,

> "Look round the world! behold the chain of love
> Combining all below, and all above.
> See plastic nature working to this end;
> Atoms to atoms—clods to crystals tend.
> See dying vegetables life sustain;
> See life dissolving, vegetate again.—
> All served, all serving, nothing stands alone,
> The chain holds on, and where it ends unknown."

Chemistry has, what are termed, its miracles and paradoxes. Gases become solids by uniting; and liquids, in a particular state, and under particular circumstances, are made to boil, by *the application of ice* to the vessels containing them.

Again, if four parts of sulphuric acid are added to one of ice, a liquid results having a temperature as high as that of boiling water; but if the proportions are reversed, and four parts of ice are added to one of acid, they produce a mixture intensely cold. In the first instance, the heat taken from the acid to dissolve the ice is much more than compensated by the contraction which takes place in the resulting liquid; but in the

second the quantity of ice being so great, makes in melting, a draught upon the caloric of the acid, which there is not a reduction in the bulk of the liquid sufficient to compensate.

It is well calculated to excite our astonishment, that many of the bodies around us which appear so inert, should consist of ingredients of such wonderful activity. It has been already mentioned that our lime-stone rocks are composed in part of carbonic acid, which when taken into the lungs is a deadly poison. Plaster of Paris, which has also lime for its basis, contains as another ingredient sulphuric, which is known to be a corrosive acid.

Fluor or Derbyshire Spar, known as the material out of which vases and mantle ornaments are fabricated, in addition to lime, consists of fluoric acid; which is so corrosive, that its vapours produce serious consequences when inhaled, and a few drops of it applied to the skin of an animal have been known to destroy it.

The bones which have been whitening in the sun and rain for half a century, and which seem as inert as clay or stone, yet contain a virulent acid, which again is composed of oxygen and a substance so inflammable, that it wastes away by slow combustion in the atmosphere, and takes fire at a heat but little above that of the animal body. And what seems yet more remarkable, prussic acid abounds in the kernels of many fruits, and is even formed during the decomposition of blood; and it might therefore be said that our bodies contain the elements of an acid, a few drops of which would prove fatal to our lives. We are thus led to remark, that we have been all our lives walking in the midst of the most explosive gases, the most noxious vapors and the most corrosive acids, the existence of which, tied down and controlled as they are by powerful affinities, we had never suspected.

Properties occasionally the most unexpected and surprising, result from the combination of the most simple substances; as where nitrogen and hydrogen themselves perfectly inodorous, uniting produce ammonia, a pungent gas which constitutes the odorous principle of the smelling salt, hartshorn &c. And carbonate of ammonia, itself a solid, results from the combination of two permanent gases. While fluoric acid, a liquid, and silex, a substance so hard as to scratch glass, and which forms the foundation of the everlasting hills, on being united are converted into a gas.

In one case, we have the rarest of substances, hydrogen being nearly fifteen times lighter than the atmosphere, forming a solid; while in the other we are presented with the fact of a

fluid, and an earth, but little inferior to the diamond in hardness, taking to themselves wings as it were, and dwelling in the form of perpetual vapor.

Such wonder-exciting results spring, not only from the union of *different* substances, but are presented by the same subtances united in different *proportions*. It is not only true that oxygen in union with carbon, is a very different substance from oxygen united to nitrogen or hydrogen; but that one proportion of oxygen united to one of these substances, is a very different compound from two of oxygen to one of them. If we take one measure of alcohol and dilute it with one of water, the properties of the alcohol though diminished are not subverted. And if another measure of water be added, the alcohol is still farther diluted, but its properties remain unchanged. Not so where the action is more decidedly chemical. One proportion of chlorine united to one of mercury, produces calomel, a mild medicine; but *two* proportions of chlorine to one of mercury, give a very different substance, corrosive sublimate, which, as its name implies, is a poison. Oxygen and carbon united in one proportion, give rise to a gas, carbonic oxide, which is lighter than the atmosphere, inflammable, and when inhaled, poisonous. In a different proportion the quantity of oxygen being doubled, another gas results having all the properties of an acid, and which has already been mentioned as an agent at once of wide diffusion and controlling energy. While in a third, the oxygen being intermediate in quantity between that of the other two, they give origin to a fixed vegetable acid, which is as unfriendly to the stomach as are the gases to the lungs.

But perhaps a more striking example is afforded by the combinations of oxygen and azote. In this case, six substances differing from each other widely in character, result from the combination of the self-same elements in different proportions. In the proportion of four volumes of nitrogen to one of oxygen they produce the atmospheric air. In that of one of each they give rise to nitrous oxide, or the exhilirating gas; in that of two of oxygen to one of nitrogen, the nitric oxide, a gas so hostile to life that warm-blooded animals immersed in it are killed almost instantly; in that of three of oxygen to one of nitrogen, to an acid called hyponitious; in that of four of oxygen to one of nitrogen, to nitrous acid; and in that of five of oxygen to one of nitrogen, the nitric acid, or *aqua fortis* of commerce. Into all these compounds the same elements enter; and they are the same which, since the hour of our birth, we

have been receiving into our lungs. Chemists have said that nitric acid is occasionally formed in the atmosphere (from its oxygen and nitrogen) by electrical agency, and that it is detected in rain-water after a thunder storm.

Can any thing be conceived more truly wonderful, than that while *one* volume of *oxygen* and *four* of *nitrogen* produce the bland, invisible, impalpable atmosphere in which plants and animals live, and without which there could be neither light nor animal or vegetable existence, *five volumes* of oxygen and *one* of nitrogen constitute an agent which dissolves metals, sets charcoal on fire, and corrodes and destroys the animal fibre almost as soon as applied to it? And must not that be esteemed a fascinating study in which truths so remarkable, and in such endless variety are presented to the mind?

Chemistry moreover, rests upon a mathematical basis. Its truths are the result of observation, and are palpable and indubitable. The mind reposes upon them with the assured confidence of demonstration. It has placed the fact beyond question, that bodies, in most cases, unite in *definite proportions*—a sublime truth, which, as has been well remarked, "deserves to be inscribed on the same tablet with the laws of gravitation and projection;" and the chemist is now able to rectify or confirm the result of his analysis by an arithmetical calculation. Even more. His knowledge of this law has enabled him in some cases to precede experiment, and like Columbus in his discovery of America, to perceive the existence of compounds before analysis had brought them to light.

Of no science is the remark of Aristotle more true, that "*experience is the basis of knowledge.*" The exhausting, unprofitable labors of the alchemists for century after century, prove how unavailing is conjecture in a science where "the way to truth lies only through the safe places of observation." Experiment tests the truth of every thing in chemistry; and its responses can neither be rejected nor gainsaid. When it has been shown, for example, that *table salt* according to the ancient definition of the term, is *no salt*, but *chlorine*, united to a *metal;* and that the base of potash is likewise a metal, as bright as quicksilver, and lighter than water, which burns brilliantly on ice, however paradoxical, we are obliged to assent to its truth.

It would seem well then, that the students of a profession, where there prevails so much uncertainty as it must be admitted still hangs over medicine, should be familiar with some ground over which they may move with a firm step. Having long doubted on the subject of the circulation of the blood, and waded

through the interminable controversy concerning the contagiousness of yellow fever, cholera and typhus; and debated the whole ground of the treatment of fever, with the doctrines of Armstrong, Broussais, &c.; and followed *Hahnemann* through his learned but startling *homœopathy*, in which he teaches that calomel and blue pill, instead of being given as we give them in the south, by the *drachm*, are to be administered in doses of a millionth, or a decillionth part of a grain; having, I repeat, thus long wandered and doubted, it may prove salutary to bring the mind back again to matters of demonstration. He was an experienced and not an injudicious teacher in our profession, who required of his pupils as a part of their course, the study of Euclid's Elements. Chemistry may be made to the student of medicine, a sort of mathematical palæstra for the discipline of his mind.

In what study indeed, can the student of medicine so well engage, when not employed upon the immediate subjects of his profession. Medicine we have seen leans upon it as an important pillar. But this apart, would any of you engage in party politics? A thousand presses, and ten thousand tongues are already busily plying this task. Like one of our swollen streams, they are sweeping over the surface of our whole country, and bearing every thing upon their turbid, tumultuous, it might be added, polluting wave. From a scene so full of angry and perturbing strife, all experience warns the lovers of science, and of philosophical repose, to keep aloof.

Do poetry and eloquence allure you? These truly are highly tempting paths; and there is an eloquence which every one may well cultivate; the eloquence of the fire-side, of the social circle, the fascinating eloquence of our countryman Franklin.

But poetry wanders far from the path of the physician. True, Darwin was a poet and a physician, and excelled in both arts. And Akenside wrote on health, as well as on the 'pleasures of the imagination.' But it is nevertheless true, that the physician has but little time to bestow upon the Muses, and the poet generally has little taste for the sober walks of philosophy.

Would you embark on the ocean of metaphysics? Every physician should be acquainted with the philosophy of the human mind. *Mens sana in corpore sano* can scarcely be preserved or restored without it. But if you will cast your eyes over the history of literature, you will find little to entice you to the extensive prosecution of this study, unless, indeed, you

are tempted by speculations which have no end; by inquiries beginning in darkness and terminating in disappointment; by protracted labor which has for its reward nothing but doubt and disquietude. You will see that the fame of the first metaphysicians of their age is beginning to wane; that the stars of Malbranche and Kant, of Locke and Descartes, and even of Stewart, and Reid, and Brown, notwithstanding their lives of laborious study, are beginning to recede from their place of pride. Need any of us hope for a kinder fate? Will any one of the present day bring to the task, more genius, or greater eloquence, or profounder learning, or a purer love of truth?

Chemistry and its sister sciences, Mineralogy, Geology, Zoology and Botany, are peculiarly congenial to your professional pursuits. Most other studies require solitude and seclusion; these may be pursued, and some of them are pursued to the best advantage, in the open fields. And the physician, as he finds his way through the country to the dwellings of his patients, may enjoy a perpetual feast in the ever-varying scene before him. Every day presents him with some new object, some novel form of vegetable life, or some new feature in the mineral kingdom. Whether able or not to find "books in the running brooks, sermons in stones, and good in every thing," brooks and trees and stones must often be his sole companions. Then "*felix qui potuit rerum cognoscere causas;*" happy is he who may discern the nature of the things before him! To the uninitiated every thing is as a sealed book. The stones hold no converse with him; the brooks are silent. He has no names for the myriads of animal beings presented to his eye, and the countless multitude of plants involve him in a perplexing labyrinth.

We live in a practical world, and in a highly practical age. The *greatest happiness principle* is the all-engrossing one, with rulers, people and philosophers. He who would enjoy consideration while he lives, or exist in the memory of future ages, must study to promote "the greatest possible happiness, of the greatest number, for the greatest length of time." A reputation based on any thing less than this, will in the very nature of things be short-lived.

The science which we are recommending, and which it has become our duty to teach, will make you *utilitarians* in the true sense of the word. Along this road, some of the first minds that adorn the annals of history have travelled to fame and immortality. Who, in fact of modern men have been of most repute? Who have filled the largest space in the worlds eye?

We speak not of poets, for it is in our nature to prefer pleasure to instruction, amusement to business; nor of statesmen, for they control the affairs which come home at once to the bosoms of men; nor of warriors, for like the comet, "shaking from its horrid hair, pestilence and war," they are sure to attract the gaze of the multitude, whose lives and rights they trample on; but of men who have traversed the orbit in which you expect to move, who have pursued science as their calling. Have any risen higher than our own Franklin, or Watt, or Count Rumford, or Sir Humphry Davy, or Newton, or Boyle, of whom we speak as of a higher order of beings? The name of Watt will float on the breath of fame while the "unconquered arm" of steam continues to widen its dominions, or history to record the achievements of genius. Count Rumford's was a life devoted steadily to the advancement of science, and the promotion of human happiness. His discoveries in chemistry placed him in the rank of the first philosophers of his day. But he deemed it an object not less worthy of his labors, to improve the construction of fire-places, to ascertain the comparative wholesomeness and value of different articles of food, and to compound soups, and devise means for feeding the poor, than to investigate the laws of caloric. And it is his glory, that he wiped away the reproach of beggary from Munich, the town in which he lived, greatly improved the condition of the indigent, won the entire confidence and favor of his enlightened sovereign, and obtained a rank among the benefactors of the human race.

Our countryman Franklin is another bright example of the advantages of a life spent in the cultivation of a *practical philosophy*. He labored to discover truth, and to apply it to some useful end. Like Count Rumford he applied his faculties to the improvement of our fire-places; and no sooner had he established the identity of electricity and lightening, and observed that they were alike attracted by points, than he set about devising means for protecting our habitations against its destructive force. He was a contributor alike to chemistry, natural philosophy and the science of government. And next to that of Washington, of all our patriots and philosophers, his is the most honored name.

Sir Humphrey Davy possessed a mind of the boldest and most original character; a quickness almost of intuition to discern the laws of nature, and patience and acuteness to test by experiment the accuracy of his theories. No one of the present age contributed so much to the improvement of chem-

ical science, or gave so many proofs of the application of that science to the practical concerns of life. And as evidence of the high estimation in which he was held in the great metropolis where he lived and labored, it may be mentioned that he was *unanimously* elected President of the Royal Society, succeeding to Sir Joseph Banks, and to the chair which had once been occupied by Sir Isaac Newton.

Let one example farther, drawn from the records of English biography, show how much richer in benefits is the cultivation of *physical* than *metaphysical* science.

Two greater philosophers than Locke and Newton never adorned the history of any country, or of any age. It was a remark of Aristotle that "there was a foolish corner even in the wise man's brain;" and yet, if there ever appeared on earth a man possessed of reason in its highest perfection it was the author of the Essay on the Human Understanding. He abjured the quiescent feelings only so far as was necessary to give him firmness of purpose, boldness of design, and energy of execution. He had no feeling or passion in excess. In his most animated controversies, where he was sometimes harshly assailed, he maintained a calm, equable, philosophic temper. During his unjust banishment, he was busy in composing works for the benefit of his country. His was a long life, sedulously devoted to science, and to the interests of his fellow-men.

Newton, though like Locke, an eminent philosopher, was not without his weak points of character. The current story of his lap-dog and papers is a fiction. That catastrophe is said to have made an impression upon his feelings from which he never entirely recovered; and it is certain, that although he lived forty-five years afterwards, he added nothing during all that time to his former brilliant discoveries. In his correspondence we hear him indulging in unjust complaints of his best friends, and see the display of a groundless jealousy, which warrants the suspicion that his great mind was obscured by a partial insanity during the evening of his life.

Such were the men living. Locke's writings conferred upon him universal popularity whilst he lived, and in his death, he was abundantly honored. His Essay on the Human Understanding was regarded as the most original and profound work of its day, and superseded all others on that subject.

But we have said that his reputation is already on the wane. His great work carries in it the seeds of a fatal disease. Its subject is a science, which, from the very nature of it, must re-

main liable to frequent changes, and which affords, therefore, no basis for a lasting reputation.

How fares it with the author of the *Principia?* He toiled in a field whose products are as useful as they are brilliant and sublime. His discoveries were alike unquestionable, as to their truth, and unequivocal in value. His fame, like the house of the wise man in the parable, is based on a rock, and the tide of time which bears down every thing but truth, has beaten upon it in vain, and the discoveries of subsequent philosophers have served only to strengthen it.

In a word, nothing which is not *useful* deserves the attention of a wise man. Let this be the motto of every student of medicine. There is much for us to do worthy of our highest, most persevering efforts, much required by our duty to ourselves, our country, our God. The shortness of human life affords no time for trifling. The faculties of the most vigorous grow weary with incessant toil, in spite of their ambition, and the time of the most industrious must often be engrossed by unimportant cares. How necessary then, that we should direct, while able, all our energies to objects which are worthy of us, knowing that perplexing and distracting cares must come, and that the night of languor, of weariness and disease, as well as of the grave, hasteneth on, in which we can do no work!

Finally, you have seen that Chemistry, along with the other branches of Natural History, having been neglected in the west, you will have the gratification of laboring in a field possessing all the charms of novelty—that a feast will be supplied continually to the mind by the presentation of new and striking phenomena in nature, evidencing every where consummate wisdom and skill in the Architect—that the study will give strength and accuracy to the powers of your minds—that as a branch of science, it has *close and important connexions with medicine;* and finally, that by the arduous pursuit of it, you may attain to eminence as scholars and philosophers.

The prospect before you is inviting, and you are allowed to indulge exhilarating hopes. There are many medals in the Natural History of the West which the industrious of you will receive; contributions to be made to the stock of science which will place the aspiring of you on the same catalogue with Linnæus, Hauy, Priestley, Lavoisier and Davy.

And let me say to you, that that individual who shall write the Natural History of the western country, present the locality of its minerals, describe its geology, the character of its animal and vegetable productions, analize its mineral waters and

describe its diseases, with the causes which give rise to, and the method of preventing and curing them, if he may not be promised the boon of immortality, will, yet, both add to the glory of his country, derive a rich present reward of fame and money, and be ranked by posterity among the effective contributors to science.